

Hypertension Incidence Is Predicted by High Levels of Hopelessness in Finnish Men

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Abstract—Recent studies have reported that hopelessness is an important factor in cardiovascular morbidity and mortality, including ischemic heart disease, acute myocardial infarction, and atherosclerotic progression. This study examined the relationship between hopelessness and incident hypertension in a population-based sample of 616 initially normotensive, middle-aged men from eastern Finland, an area with high rates of cardiovascular disease. Participants completed a medical examination and a series of psychological questionnaires at baseline and at the 4-year follow-up. Hopelessness was measured by 2 items assessing negative expectancy about the future and one's goals. A logistic regression model with adjustments for age, body mass index, baseline resting blood pressure, physical activity, smoking, alcohol consumption, education, parental history of hypertension, and self-reported depressive symptoms revealed that men reporting high levels of hopelessness at baseline were 3 times more likely to become hypertensive (systolic blood pressure ≥ 165 mm Hg and/or a diastolic blood pressure ≥ 95 mm Hg or confirmed use of antihypertensive medication) in the intervening 4 years than men who were not hopeless (odds ratio, 3.22; 95% confidence interval, 1.56, 6.67). Men reporting moderate levels of hopelessness were not at a significantly increased risk of hypertension (odds ratio, 1.27; 95% confidence interval, 0.79, 2.07). This is the first study to identify a significant relationship between hopelessness and incident hypertension. Research is needed to explore the neuroendocrine and central nervous system mechanisms underlying this association. (*Hypertension*. 2000;35:561-567.)

Key Words: cardiovascular diseases ■ depression ■ hopelessness ■ men ■ psychology ■ risk factors

Several risk factors for hypertension that have important lifestyle and psychosocial components have been identified, including obesity,¹ excess sodium consumption,² excess alcohol consumption,³ and physical inactivity.^{4,5} All are associated with an increased risk of hypertension. Research also suggests that psychosocial stress and concomitant sympathetic nervous system reactivity may play a role in hypertension and increases in blood pressure (BP) over time,⁶⁻⁸ as may certain emotions, including anger, anxiety, and depression.⁹⁻¹¹

Previously, we reported that hopelessness, characterized as a sense of futility and negative expectations about the future and one's personal goals, predicts incident myocardial infarction and cardiovascular mortality¹² and is associated with a faster progression of carotid atherosclerosis¹³ in middle-aged men. In both cases, the effects of hopelessness on cardiovascular disease morbidity and mortality were unchanged after controlling for depressive symptoms in general. Data from the National Health Examination Follow-up Survey also demonstrated that hopelessness was related to incident fatal and nonfatal ischemic heart disease in men and women

during 12 years of follow-up and that the effect of hopelessness was stronger than the effect of depression on outcomes.¹⁴ In other words, hopelessness seems to have cardiovascular consequences that are distinct from or stronger than those associated with depression. It is important to note, however, that hopelessness is often a major symptom of depression and, thus, it can be difficult to disentangle these constructs. It may be that hopelessness is a critical component or feature of depression which affects cardiovascular function and that other symptoms of depression are more weakly related or unrelated to cardiovascular disease risk.

To the best of our knowledge, no previous study has specifically examined the effect of hopelessness on hypertension, although recent studies have examined the relationship between depression and hypertension. Data from the Coronary Artery Risk Development in Young Adults study showed that depression predicted incident hypertension over a 5-year period in young black but not white adults.¹⁵ Also, results from the first National Health and Nutrition Examination Survey Epidemiologic Follow-up Study indicated that high levels of depression and anxiety predicted the onset of

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hypertension 7 to 16 years later in middle-aged white persons and in young and middle-aged black people.¹¹ These 2 studies did not assess the specific effects of hopelessness on BP elevation.

The present study used data from the Kuopio Ischemic Heart Disease Risk Factor Study (KIHD) to investigate the association between hopelessness and incident hypertension, independent of depression. Information on health habits, family illness history, and several anthropometric and demographic measures enabled us to examine the potential confounding influences of other risk factors for hypertension.

Methods

Study Population

The KIHD study is a population-based study of biological, psychosocial, and socioeconomic risk factors for atherosclerotic vascular disease, ischemic heart disease, mortality, and other outcomes¹⁶ in middle-aged men from Kuopio and its surrounding communities in Eastern Finland, a region with high coronary morbidity and mortality.¹⁷ A total of 2682 participants (82.9% of those eligible) aged 42, 48, 54, or 60 years were enrolled in the study in 2 cohorts: 1166 men aged 54 years (83.3% of those eligible) were enrolled between March 1984 and August 1986, and a second cohort of 1516 men aged 42, 48, 54, and 60 years (82.6% of eligible) were enrolled between August 1986 and December 1989. Ultrasound examinations of the right and left carotid arteries were performed on 1229 men from the second cohort as part of their baseline examination. These participants were invited to take part in a follow-up study, which was conducted between March 1991 and December 1993. Of the 1229 men who were eligible for follow-up, 1038 (88.2%) participated. Of the remaining men, 52 could not participate because of death, severe illness, or migration; 107 refused; and 32 could not be contacted. Follow-up ranged from 3.8 to 5.2 years, with an average of 4.2 years. The KIHD study protocols for the baseline and follow-up examinations were approved by and conducted in accordance with the research guidelines established by the University of Kuopio Research Ethics Committee. Respondents were not paid for participation, and all gave informed consent at baseline and follow-up.

For the present analyses, subjects were excluded if they had missing BP data at baseline or follow-up ($n=3$), were hypertensive at baseline (which was defined as a resting BP $\geq 165/95$ mm Hg [$n=239$] or a confirmed use of antihypertensive medications [$n=157$]), had incomplete information on the hopelessness scale ($n=22$), or had missing data on the covariates at baseline ($n=1$). Thus, the findings of the present study are based on 616 initially normotensive men who had complete data on the measures of hopelessness and all covariates at baseline and for whom hypertension status at follow-up was determined. Subject characteristics are shown in Table 1. Comparison of the 422 KIHD participants excluded from the current analyses with the 616 subjects who had complete data revealed no differences in mean reported hopelessness, age, parental history of hypertension, and average weekly physical activity or smoking status; however, those who were excluded tended to be less educated, consumed more alcohol per week, had a higher body mass index (BMI), reported more depressive symptoms and, as would be expected, had higher resting BPs ($P<0.001$).

Baseline and Follow-Up Examinations

Examinations were conducted on 2 days, 1 week apart, at both baseline and follow-up. They included a number of physiological, biochemical, anthropometric, and psychosocial measures (see reference 15 for complete details). Medical history and medication use were checked during a medical examination at both baseline and follow-up.

TABLE 1. Baseline Subject Characteristics: KIHD Risk Factor Study, 1986 to 1993

	Means (SD)	Prevalence, %
Age, y	50.4 (6.6)	
BMI, kg/m ²	25.9 (3.0)	
SBP, mm Hg	126.4 (11.3)	
DBP, mm Hg	83.2 (7.2)	
Physical activity, h/wk	2.2 (2.5)	
Smoking status, %		
Never		28.0
Former		38.9
Current		33.1
Alcohol consumption, %		
Abstainers		10.4
Light (<3 drinks/week)		43.9
Moderate (3–13 drinks/week)		35.5
Heavy (14+ drinks/week)		10.2
Parental history of hypertension, %		39.8

$n=616$. Among smokers, average pack-years was 25.0 (16.8). Among drinkers, average weekly alcohol consumption was 77.8 g (104.0 g) (≈ 6 drinks per week).

Hopelessness Scale

Hopelessness was measured by 2 items from a battery of psychosocial questionnaires administered at baseline. These items were "The future seems to me to be hopeless, and I cannot believe that things are changing for the better" and "I feel that it is impossible to reach the goals I would like to strive for." Using a 5-point scale, respondents indicated the degree to which they agreed with each item (0=absolutely agree, 1=somewhat agree, 2=cannot say, 3=somewhat disagree, or 4=absolutely disagree). A hopelessness score was created by reverse-coding and summing across items. The mean (SD) hopelessness score was 2.4 (1.96), with a range of 0 to 8. Three groups were formed based on response options and the meaning of the scores as follows: men scoring 0, 1, or 2, which indicated general disagreement with each statement, were considered low in hopelessness (59.74%); those with scores in the midrange of the scale (3, 4, or 5), reflecting a mixed response to the items, formed the moderately hopeless group (31.82%); and men scoring 6, 7, or 8, which is consistent with general agreement with both statements, were considered high in hopelessness (8.44%).

BP Measurement

BP was measured by a trained observer with a random-zero muddler sphygmomanometer (Hawksley). BP measurements were completed on the first examination day at both baseline and follow-up. The protocol was as follows: subjects rested in the supine position for 15 minutes and had BP measured at minutes 5, 10, and 15; they then stood (standing rest) and had one reading taken after 1 minute; and finally, after 10 minutes of seated rest, subjects had BP measured at minutes 5 and 10. The last 2 supine and the 2 seated measurements were averaged to obtain resting systolic BP (SBP) and diastolic BP (DBP).

Hypertensive Status at Follow-Up

A participant was considered hypertensive at the 4-year follow-up examination if his resting SBP was ≥ 165 mm Hg or his resting DBP was ≥ 95 mm Hg or if he was currently taking antihypertensive medications, as confirmed during the medical examination. A total of 126 men (20.4%) met these criteria.

Assessment of Baseline Covariates

Baseline covariates were chosen on the basis of prior research that showed their important associations with hypertension. To control

for the effects of depression and specifically assess the relationship between hopelessness and risk of hypertension, we also included a covariate representing self-reported depressive symptoms. Measurements of covariates are described below.

Age

Baseline age was modeled by dummy-coded variables for ages 48, 54, and 60 years, with an age of 42 years as the reference category.

BMI

BMI was calculated as weight (kg) divided by height squared (m²). It was modeled continuously.

Cigarette Smoking

Smoking was assessed by self-report (never, former, or current). Current smoking was modeled continuously as pack-years, and former smokers were modeled with a dummy-coded variable. Never smoked was the referent.

Alcohol Consumption

Consumption of beer, wine, and spirits was assessed by a questionnaire on drinking behavior during the previous 12 months and by a 4-day dietary record. Alcohol consumption was calculated as grams per week and modeled continuously.

Physical Activity

Baseline physical activity was assessed by a self-report of leisure-time activities for the previous 12 months with a questionnaire modified from the Minnesota Leisure Time Physical Activity Questionnaire to represent 16 of the most common leisure-time physical activities of middle-aged Finnish men.¹⁸ For each activity, participants reported whether they engaged in the activity and, if they did, the frequency per month over the past year, average duration per occasion, and the intensity level at which the activity was performed. Each activity was assigned metabolic units according to reported intensity. Detailed information on the calculation, reliability, and validity of the physical activity measures was described previously.¹⁹ A continuous intensity-dependent measure of total duration of leisure-time physical activity, previously associated with type 2 diabetes in the KIID population,²⁰ was used in the analyses.

Education

Education was recorded as number of years of school completed and modeled continuously.

Parental Hypertension

Parental history of hypertension was measured by participant self-report of maternal and paternal hypertension. A dummy-coded variable was used in analyses, with a value of "1" assigned to any subject who reported that 1 or both parents were hypertensive.

Resting SBP

Resting SBP was the average of 2 supine and 2 seated readings, as described above, and modeled continuously.

Depressive Symptoms

Depressive symptoms were measured by an 18-item depression scale developed by Roberts and colleagues²¹⁻²³ that assesses mood disturbances, negative self-concept, problems with eating and sleeping, loss of energy, and psychomotor agitation or retardation. This scale assesses somatic or vegetative symptoms of depression, but it does not include any items on hopelessness. One point was assigned for each "true" or "false" answer that corresponded to a depressed response; higher scores indicate more symptoms. This scale has good internal consistency and demonstrated reliability,²³ although it does not include all clinical criteria for major depression. Prior research found that this scale is similar conceptually to other brief symptom checklists and that it correlated significantly with the Beck Depression Inventory in an outpatient clinical population ($r=0.66$).²² High scores on this depression scale previously predicted excess stroke mortality in a middle-aged and elderly population.²⁴ Depressive symptoms were modeled continuously.

TABLE 2. Hopelessness and Risk of Hypertension: KIID Risk Factor Study

Hopelessness	Model 1		Model 2	
	OR	95% CI	OR	95% CI
Low	Referent		Referent	
Moderate	1.40	0.90, 2.17	1.27	0.79, 2.07
High	2.79	1.49, 5.22	3.22	1.56, 6.67

n=616; 126 cases of hypertension were identified at follow-up. Model 1 is adjusted for age. Model 2 is adjusted for age, baseline resting SBP, smoking, alcohol consumption, physical activity, BMI, parental history of hypertension, education, and self-reported depressive symptoms.

Data Analyses

The association between hopelessness and hypertensive status at the 4-year follow-up was assessed using age-adjusted logistic regression models with hopelessness modeled continuously and categorically. Subsequent age-adjusted regression models examined potential confounding by BMI, smoking, alcohol consumption, physical activity, education, depressive symptoms, positive parental history of hypertension, and baseline resting SBP. Separate age-adjusted analyses were conducted to determine the associations between depressive symptoms and hypertension risk and between hopelessness and depression. Statistical analyses were performed with LOGISTIC, GLM, and CORR procedures from SAS version 6.12 software (SAS Institute).

Results

Hopelessness and Risk of Hypertension

An age-adjusted logistic regression model with hopelessness modeled continuously showed that each 1-point increase in hopelessness was associated with a 16% greater risk of hypertension (odds ratio [OR], 1.16; 95% confidence interval [CI], 1.05, 1.28). This association was unchanged after adjustments for cigarette smoking, alcohol consumption, BMI, resting SBP, physical activity, education, parental history of hypertension, and depressive symptoms (OR, 1.15; 95% CI, 1.02, 1.29). Subsequent logistic regression models with hopelessness modeled categorically showed that the men who had the highest levels of hopelessness at baseline were 3 times more likely to become hypertensive 4 years later than men who were not hopeless, after adjusting for age and other risk factors. Hypertension risk was slightly elevated in moderately hopeless men, but this increase was not significant. Table 2 shows the ORs and 95% CIs from the age- and risk factor-adjusted models for low, moderate, and high hopelessness in relation to incident hypertension at the 4-year follow-up.

Effect of Atherosclerotic Progression

We previously reported that high levels of hopelessness were associated with the accelerated progression of carotid atherosclerosis over 4 years in the KIID study.¹³ Because atherosclerosis can contribute to increased vascular resistance and elevations in BP, we then examined the effects of hopelessness on the risk of hypertension, taking into account the 4-year changes in atherosclerosis. Results from this logistic regression model were nearly identical to the risk factor-adjusted model reported in Table 2, with more than a 3-fold increased risk of hypertension among the most hopeless men

TABLE 3. Hopelessness, Risk of Hypertension, and Behavioral Changes

	OR	95% CI
Continuous model		
Hopelessness	1.24	1.10, 1.40
Categorical model		
Low hopelessness		Referent
Moderate hopelessness	1.50	0.90, 2.49
High hopelessness	4.51	2.14, 9.48

n=570; 111 incident cases of hypertension. Models included adjustments for age, resting SBP, education, parental history of hypertension, and 4-year changes in smoking, alcohol consumption, BMI, and physical activity.

(OR, 3.18; 95% CI, 1.53,6.60) and a small but nonsignificant increased risk in the moderately hopeless group (OR, 1.27; 95% CI, 0.78, 2.07). Thus, atherosclerotic changes did not account for the increased risk of hypertension associated with high levels of hopelessness.

Effect of Behavioral Changes

It is well known that depressed or hopeless individuals are less likely to be medically compliant, less able to make behavioral changes,²⁵ more likely to smoke and abuse alcohol,^{14,26-28} and less likely to be physically active.^{29,30} Because these lifestyle habits are also risk factors for hypertension, we examined the influence of hopelessness on hypertension after taking into account 4-year changes in alcohol consumption, smoking, physical activity, and BMI. Data on behavioral risk factors at baseline and at 4-year follow-up were available for 570 participants. Results from the separate logistic regression models in which hopelessness was modeled continuously and categorically are presented in Table 3. These analyses show a somewhat stronger association between hopelessness and hypertension risk than was seen in the models that adjusted only for baseline risk factors. This pattern of findings indicates that the most hopeless men did not show worse behavioral profiles during the 4 years of follow-up, which was confirmed by separate analyses of behavioral changes. Overall, participants increased their alcohol consumption slightly, gained weight (as evidenced by greater BMI), and increased their activity levels, but smoking rates changed little over 4 years. However, none of these changes (or lack of changes) differed by level of reported hopelessness at baseline.

We also examined interactions between hopelessness and smoking and alcohol consumption but found no significant effects. Our results imply that behavioral or lifestyle factors are not the mechanisms by which hopelessness increases hypertension risk in this population.

Hopelessness and 4-Year Change in BP

Next, we assessed the relationship between hopelessness and change in BP over the 4 years of follow-up, regardless of hypertensive status at follow-up. Mean (SD) changes in SBP and DBP were 3.8 (11.3) and 1.4 (7.4) mm Hg, respectively. Results were consistent with, although not as strong as, the results from our primary analyses. Linear regression models adjusted for age and baseline resting BP demonstrated that

increasing hopelessness was associated with greater changes in SBP and DBP ($\beta=0.314$ and 0.235 , respectively, for SBP and DBP change), but these changes were only marginally significant ($P<0.16$). However, contrasting low and high hopelessness groups showed that highly hopeless men had significantly higher SBPs ($\mu=133.2$ and 130.1 mm Hg for high and low hopelessness groups, respectively; $P<0.05$) and marginally higher DBPs ($\mu=86.2$ and 84.4 mm Hg for high and low hopelessness groups, respectively; $P<0.09$) at follow-up after adjusting for age and baseline resting BP.

Depression and Hypertension Risk

Logistic regression revealed that each 1-point increase on the depression scale was related to a nonsignificant 8% increase in risk of hypertension (OR, 1.08; 95% CI, 0.98, 1.19), which decreased to 6% in the multivariate model ($P<0.29$). Consistent with our prior research,²³ we also modeled depression categorically, using a criterion of ≥ 5 symptoms to define depression. A total of 51 participants (8.3%) reported ≥ 5 depressive symptoms, and this group had a nonsignificant elevated risk of hypertension (OR, 1.58; 95% CI, 0.78, 3.22 after risk factor adjustment). Although depression was weakly related to hypertension, it was modestly and significantly associated with hopelessness ($r=0.36$; $P<0.0001$) after adjustment for age.

Discussion

This study demonstrates that normotensive men who experience high levels of hopelessness are at a significantly increased risk of becoming hypertensive over a 4-year period relative to their nonhopeless counterparts. To our knowledge, this is the first prospective study to demonstrate a relationship between reported hopelessness and subsequent hypertension in middle-aged men. Our findings add to our earlier work in which we reported significant associations between hopelessness and an increased risk of all-cause and cause-specific mortality, incident myocardial infarction, and progression of carotid atherosclerosis.^{12,13} Taken together, our data clearly show that hopelessness has profound adverse effects on cardiovascular function.

Hopelessness was also associated with 4-year increases in BP, regardless of hypertensive status, although these associations were not as pronounced as our primary findings. It is unclear why this pattern was observed. Mean 4-year changes in BP were relatively small in magnitude in our sample, and it may be that some regression to the mean occurred. A longer follow-up period with additional BP measurements or a larger sample with more individuals reporting hopelessness would allow a closer examination of this pattern.

The observed association between hopelessness and hypertension was not confounded or modified by traditional risk factors for hypertension or by overall depressive symptoms. We included a covariate for depressive symptoms because we wanted to determine if hopelessness was simply a proxy for depression, as is frequently assumed in the literature, or if it had distinct effects on health. Consistent with our previous research,^{12,13} the effect of hopelessness was not confounded by self-reported depressive symptoms. In this study, our measures of hopelessness and depression were reliably but

modestly correlated, and depression was not significantly related to incident hypertension, which indicates that hopelessness is not synonymous with depression in this population. It is possible that this measure of depression does not adequately tap the experience of depressive symptoms in this Finnish population; however, we have no a priori or post hoc reason to suspect that this is true. The depression scale assessed the somatic or vegetative symptoms of depression but did not include an item on hopelessness, which is a common symptom of depression. This scale does not fully reflect clinical criteria for depressive disorders, but it is similar to symptom checklists such as the Center for Epidemiologic Studies Depression scale, which is widely used in epidemiological studies of depression.^{31,32}

To the best of our knowledge, previous research on the relationship between depression and cardiovascular disease has rarely examined the effects of specific symptoms, particularly hopelessness. Severe depression is almost always accompanied by feelings of hopelessness; however, it should be noted that depression can occur without hopelessness and that individuals may experience hopelessness without meeting criteria for depression. Our findings indicate that hopelessness either has unique cardiovascular effects or is, in fact, a critical component of depression that confers increased cardiovascular disease risk. If this latter point is true, it may help explain some of the inconsistencies in the literature on depression and mortality and cardiovascular outcomes, particularly in nonclinical or population samples.³³ More research is needed to further examine the specific impact of hopelessness and other symptoms of depression.

Lack of confounding of the hopelessness-hypertension association by known risk factors raises the important question of mechanism(s). It may be surprising that risk behaviors at baseline, including smoking, drinking, physical inactivity, and obesity, and change (or lack of change) in those behaviors during the 4 years of follow-up did not explain the excess hypertension risk associated with high hopelessness. In fact, behavioral changes did not differ by reported hopelessness at baseline. Previous clinical observations suggest that depressed or hopeless individuals are less able to make behavioral changes and less medically compliant than nondepressed persons.²⁵ However, the present study was observational, not clinical, and we did not assess medical compliance; any behavioral alterations that participants may have made over the course of the study were not intentionally directed by the study. It is widely recognized that it is difficult to modify behaviors to lessen risk profiles, so it seems that the minor changes observed in this study reflect the aging of our population and are unrelated to feelings of hopelessness.

Persons experiencing high levels of hopelessness likely undergo neuroendocrine or hormonal alterations that influence vascular function and/or central nervous system pressor control mechanisms. We were unable to assess hormonal factors that could be influenced by hopelessness and, thus, result in vascular changes that would lead to sustained elevations in BP. Moreover, to our knowledge, no prior investigations of biochemical alterations specifically associated with hopelessness have been published. Such relationships are biologically plausible, however. Most of the rele-

vant evidence comes from neuroendocrine studies of depression. For example, several lines of evidence indicate that hypothalamic-pituitary-adrenal (HPA) axis function is altered in depression, resulting in increased cortisol secretion.³⁴⁻³⁶ Small increases in glucocorticoids, including cortisol, over long periods can result in hypertension, as well as visceral obesity, insulin resistance, increased plasma lipids, and coagulation changes, all of which are precursors to cardiovascular disease.^{37,38} Prior research has not specifically examined HPA function with respect to hopelessness; thus, it is unknown whether HPA dysregulation and the resulting cortisol increases are greater in persons who are hopeless relative to those who are depressed. Some evidence is suggestive, however. Research shows that hopelessness is a better predictor of suicidal ideation and behavior than is depression per se,^{39,40} and some of the data demonstrating HPA hyperactivity in depression comes from suicide victims.⁴¹ In addition, although not unequivocal, research suggests that hypercortisolemia may be greater in persons with more severe depression (see reference 42 for review), which, as noted above, is generally accompanied by feelings of hopelessness, and in depressed persons who complete or attempt suicide compared with depressed individuals who are not suicidal.⁴³

Persons experiencing hopelessness also may show alterations in serotonin, which has known vasoconstrictive properties and is involved in platelet activation, thrombogenesis, and hypertension.⁴⁴⁻⁴⁹ Again, most of the evidence for serotonergic abnormalities comes from studies of the neuroendocrinology of depression. Research has consistently shown that cerebrospinal fluid concentrations of 5-hydroxyindoleacetic acid (5-HIAA), the major serotonin metabolite, are decreased in depressed, drug-free individuals, and even lower in depressed persons who attempt suicide.⁵⁰⁻⁵² Autopsy studies on depressed and suicidal patients also found reduced concentrations of serotonin and 5-HIAA in postmortem tissue.⁵³⁻⁵⁵ The fact that hopelessness is more strongly related to suicide than is depression, as noted above, suggests that the serotonergic abnormalities observed in depressed suicidal patients may, in fact, be related to higher levels of hopelessness in such patients. Interestingly, 1 study reported that 5-HIAA in the cerebrospinal fluid was correlated with cognitive but not vegetative symptoms of depression, whereas cortisol was correlated with both types of symptoms.⁵⁶

Taken together, the available evidence, albeit indirect, suggests that HPA dysfunction and serotonergic abnormalities may be associated with hopelessness and cardiovascular disease risk. Other critical hormonal and neuroendocrine changes may also occur with hopelessness and influence vascular function. Given that traditional risk factors cannot account for the excess cardiovascular risk associated with hopelessness, research on the hormonal and neuroendocrine effects of hopelessness and their relationship with cardiovascular function is especially warranted.

Hypertensive status was determined by resting BP measured during the follow-up examination or by confirmed use of antihypertensive medications. Fewer than 7% of participants reported using antihypertensive medications at follow-

up. In other words, most of the men who were hypertensive at follow-up had an average BP $\geq 165/95$ mm Hg, as measured during their clinical examination. This was based on the average of 2 supine and 2 seated readings. The Sixth Joint National Committee on the Detection, Evaluation, and Treatment of High Blood Pressure⁵⁷ recommends that hypertension be diagnosed only after high BP readings are obtained on at least 2 clinic visits. Consequently, our participants cannot be diagnosed as hypertensive based on their follow-up BP readings alone. The committee also defines hypertension as a SBP ≥ 140 mm Hg and/or a DBP ≥ 90 mm Hg. However, because we had only a single visit to determine hypertensive status at follow-up, we chose a conservative cut point for hypertension ($\geq 165/95$ mm Hg), which we have used previously in research on hypertension in this population^{6,9} and which is similar to cut points used in other investigations.^{10,11} Moreover, available data on nearly 93% of our participants who measured their BP at home for 6 days using a portable, oscillometric monitor indicate good agreement between the average home BP and the BP assessed during the study protocol (age-adjusted $r=0.67$ for SBP and 0.66 for DBP; $P<0.0001$). These findings indicate that many of the men who met our study criteria for hypertension would also meet clinical criteria for diagnosed hypertension.

The results of the present study are based on a relatively homogeneous population of middle-aged white men from a discreet geographic area (eastern Finland). It is unknown whether similar associations would be observed in women, younger or older persons, or individuals from varying racial groups or ethnic backgrounds. Hopelessness is strongly and inversely related to socioeconomic status (SES)⁵⁸ but does not differ by sex.^{59,60} In contrast, female sex is a stronger predictor of depression than either income or education.⁶⁰ It is widely recognized that women and nonwhite minorities are more likely to be of lower SES, particularly in the United States. Moreover, hypertension follows an SES gradient. Education did not explain the impact of hopelessness on hypertension risk in this study. We also examined the influence of income as another measure of SES, and it too did not alter the observed relationship between hopelessness and hypertension (data not shown). Nevertheless, the extent to which sex or race might modify the association between high BP and hopelessness is unknown and deserves further study.

In summary, this study identified high levels of hopelessness as a significant, independent predictor of BP elevation over a 4-year period in middle-aged men. Findings are consistent with our previous research on the cardiovascular effects of hopelessness,^{12,13} as well as data from a national study of US adults.¹⁴ With $\approx 8\%$ of our sample reporting strong feelings of hopelessness, a relatively small number of men seem to be at risk for the adverse health consequences of hopelessness. However, the observed 3-fold risk is striking and essentially not confounded by known cardiovascular risk factors. Our data support the idea that hopelessness is more strongly related to adverse cardiovascular consequences than is depression; however, additional work is needed to test this hypothesis and to determine if hopelessness is the critical feature of depression that confers increased cardiovascular risk. Moreover, future research should examine physiological

mechanisms by which hopelessness affects vascular function, which may inform strategies for treating patients experiencing hopelessness. Importantly, work is also needed to address the determinants of hopelessness and ways to alleviate it.

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